National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Monitoring of radioactivity in the Netherlands

National Radioactivity Monitoring Network – results 2020 and 2021

RIVM letter report 2023-0083
P.P. Bosch

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Synopsis

Monitoring of radioactivity in the Netherlands

National Radioactivity Monitoring Network – results 2020 and 2021

In 2020 and 2021, the Netherlands fulfilled its annual European obligation to measure how much radioactivity is present in the environment. Radioactivity levels measured by the National Radioactivity Monitoring Network were normal, as in previous years.

All countries of the European Union are required to perform these measurements each year under the terms of the Euratom Treaty of 1957. The Netherlands performs these measurements following the guidance issued in 2000.

The measurements represent the background values for radioactivity that are present under normal circumstances. They can be used as reference values, for instance, during a nuclear emergency.

The results on radioactivity in the environment are reported to the European Commission by the National Institute for Public Health and the Environment (RIVM) on behalf of the competent authority in the Netherlands.

Keywords: monitoring network, radioactivity, ambient dose equivalent rate

Publiekssamenvatting

Monitoring van radioactiviteit in Nederland

Nationaal Meetnet Radioactiviteit – resultaten 2020 en 2021

In 2020 en 2021 voldeed Nederland aan de Europese verplichting om elk jaar te meten hoeveel radioactiviteit in het milieu zit. De niveaus radioactiviteit gemeten met het Nationaal Meetnet Radioactiviteit laten een normaal beeld zien, net als de jaren ervoor.

Alle landen van de Europese Unie zijn volgens het Euratom-verdrag uit 1957 verplicht om deze metingen te doen. Nederland volgt daarbij de aanbevelingen uit 2000 op om de metingen op een bepaalde manier uit te voeren.

De metingen leveren achtergrondwaarden op, ofwel radioactiviteitsniveaus die er onder normale omstandigheden zijn. Deze waarden kunnen bij bijvoorbeeld calamiteiten of rampen als referentie dienen.

Het RIVM brengt namens de Autoriteit Nucleaire Veiligheid en Stralingsbescherming (ANVS) verslag uit aan de Europese Unie over radioactiviteit in het milieu.

Kernwoorden: meetnet, radioactiviteit, omgevingsdosisequivalenttempo

Disclaimer

The Authority for Nuclear Safety and Radiation Protection (ANVS, Koningskade 4, The Hague; https://english.autoriteitnvs.nl/) has given RIVM, Centre for Environmental Safety and Security, department SMA (RIVM, Antonie van Leeuwenhoeklaan 9, 3721 MA Bilthoven) the assignment to perform the measurements presented here and to make this report.

Department SMA of the Centre for Environmental Safety and Security of the National Institute for Public Health and the Environment (RIVM) has been accredited by the Dutch Accreditation Council (RvA) according to NEN-EN-ISO/IEC 17025:2017 (RvA: L153 Testing) for a number of procedures. In this report, the determination of the ambient dose equivalent rate is performed within the scope of this accreditation. The determination of the gross α activity concentration and any opinions and/or interpretations that are expressed are outside the scope of the accreditation.

Contents

Summary

The National Radioactivity Monitoring Network (NMR) is used to determine the activity concentrations of gross α and artificial β (β radiation emitted by man-made radionuclides) in air dust in the Netherlands. The yearly average gross α activity concentrations in air dust were 3.5 $Bq \cdot m^{-3}$ in 2020 and 3.0 $Bq \cdot m^{-3}$ in 2021. This level is comparable to previous years, with the exception of 2018, when the higher level could be attributed to the lower yearly precipitation. The yearly average of the artificial β activity concentration did not deviate significantly from zero. The NMR was also used to determine the ambient (gamma) dose equivalent rate: the yearly averages were 82 $nSv \cdot h^{-1}$ in 2020 and 81 $nSv \cdot h^{-1}$ in 2021.

1 Introduction

This report presents data on gross α and artificial β activity concentrations in air dust and ambient (gamma) dose equivalent rates, as measured by the National Radioactivity Monitoring Network (Nationaal Meetnet Radioactiviteit, NMR) in 2020 and 2021.

The NMR consists of 164 sites [1], at which the ambient dose equivalent rate is determined. At 13 measuring sites (until 2019 14 sites), gross α and artificial β activity concentrations are determined, as well as the ambient dose equivalent rate (at a height of 3.5 m above ground level) [2]. At the other 151 measuring sites, only the ambient dose equivalent rate is determined (at 1 m above ground level). The data on gross α and artificial β differ from the ones collected at the RIVM location in Bilthoven [3] in sample size, sampling frequency and analytical procedures (including a different approach to the contribution of short-lived natural radionuclides, i.e. radon daughters).

Since the dose equivalent rate monitors are placed differently at the 13 measuring sites (where activity concentrations are determined) with respect to the 151 sites with regard to height and surface covering, results can differ between the two types of measuring sites [4]. For this reason, these 13 dose equivalent rate monitors are not taken into account when calculating the yearly average ambient dose equivalent. The reported artificial β activity concentrations are calculated by the monitors from the difference between the measured gross β activity concentration and the natural gross β activity derived from the measured gross α activity concentration.

The data presented here are based on 10 minute measurements. Averages over the year are calculated for each location using daily averages derived from the 10 minute measurements. The 5^{th} and 95^{th} percentiles given in this report are the percentiles of the daily averages. The yearly averages and percentiles for all stations are given in Table 1 till Table 4.

The data on external radiation, expressed in ambient dose equivalent, contain a systematic uncertainty because of an overestimation of the cosmogenic dose rate due to the characteristics of the detectors. NMR data are not corrected for these response uncertainties.

[1] Throughout the years, the number of sites changes due to for example refurbishment or dismantling of sites. The number of sites mentioned here is the current amount of stations.
[2] C.J.W. Twenhöfel, C. de Hoog van Beynen, A.P.P.A. van Lunenburg, G.J.E. Slagt, R.B. Tax, P.J.M. van Westerlaak, F.J. Aldenkamp, 2005. Operation of the Dutch 3rd Generation National Radioactivity Monitoring Network. In: Automatic Mapping Algorithms for Routine and Emergency Monitoring Data, Spatial Interpolation Comparison 2004 by IES, G. Dubois (ed.), European Committee, JRC, EUR 21595 2005, 19–31.
[3] For a description see Chapter 2 of Environmental radioactivity in the Netherlands: Results in 2018, RIVM Report nr. 2019-0216, ed. CP Tanzi, published in 2020.
[4] R.O. Blaauboer and R.C.G.M. Smetsers, 1996. Variations in outdoor radiation levels in the Netherlands. Thesis University of Groningen, Groningen.

2 Results

An impression of the spatial variation in the yearly averages of the NMR data in 2020 and 2021, constructed by using the RIVM's Geographical Information System (GIS), is shown in Figure 1 and Figure 3 for average gross α activity concentration and for the average ambient dose equivalent rate respectively. An inverse distance weight interpolation algorithm was applied to calculate values between the NMR stations.

In 2020, the yearly average gross α activity concentration in air dust was 3.5 $Bq \cdot m^{-3}$ (based on the yearly averages of the 13 measurement locations). In 2021 this average was 3.0 $Bq \cdot m^{-3}$ (based on 13 measurement locations). Figure 2 presents the yearly averages of the gross α activity concentration since 1990. The yearly averages gross α activity concentration in air dust in 2020 and 2021 are comparable to the concentration in previous years, as illustrated in Figure 2, with the exception of 2018. The higher concentration in 2018 can be attributed to the lower yearly precipitation in 2018: in 2018 the surface average precipitation was 607 mm, compared to 783 mm in 2019 (source: KNMI). When comparing the 2020 and 2021 values (yearly average of 3.5 $Bq \cdot m^{-3}$ and 3.0 $Bq \cdot m^{-3}$ respectively) with data collected before 2002, it should be noted that the measurements from 2002 onwards are 20% higher, as can be seen in Figure 2. This is attributed to a change in type of monitor.

During the second half of 2002, the 14 aerosol FAG FHT59S monitors were gradually replaced by 14 Berthold BAI 9128 monitors [5]. Due to differences in detection method, filter transport, calibration radionuclides and algorithms, the results for the activity concentrations from the two types of monitor are not exactly the same. By running both monitors simultaneously at the same location, the measured gross α activity concentration was compared. On average, the Berthold monitor systematically reported about 20% higher values than the FAG monitor [6]. The estimated random uncertainty for both types of monitor is about 20%. No correction was applied for the difference in the gross α activity concentration between the Berthold and FAG monitors.

The yearly averages of the artificial β activity concentration in 2020 and 2021 do not deviate significantly from zero.

In 2020, the yearly average for the ambient dose equivalent rate was 82 $nSv \cdot h^{-1}$. In 2021 this average was 81 $nSv \cdot h^{-1}$. Figure 4 presents the yearly averages of the ambient dose equivalent rate since 1996.

In 2020, the analysis of the ambient dose equivalent rate has been based on a set of 152 stations. All these stations were active for more than 150 days. So all stations were used to calculate the yearly averages. In 2021, the NMR consisted of 151 stations of which 150 were active for more than

[5] In 2019, one of the monitors was permanently dismantled making the total number of active monitors 13.
[6] C. de Hoog and R.B. Tax, 2003. Achtergronddocument bij NMR integrale rapportage 2002. RIVM Bilthoven, internal report.

150 days. So, in 2021 the yearly average ambient dose equivalent rate was calculated using these 150 stations.

The yearly averages of 2020 and 2021 were similar to the values of 2015-2019, and is significantly higher than the values measured before 2014, as can be seen in Figure 4. This increase of the ambient dose equivalent rate coincides with and is attributable to the replacement of the monitors.

From November 2014 until the end of 2015, most of the ambient dose equivalent monitors were replaced. The Bitt RS03 monitors (proportional counters) were replaced by new Saphymo XL-2-3 monitors (Geiger-Müller). The energy response, cosmic response and self-effect of the two types of monitor differ slightly. Compared with the Bitt monitor, the Saphymo monitor measurements are, on average, 8 $nSv \cdot h^{-1}$ higher at the natural background radiation level in the Netherlands. No correction for this difference is applied.

Figure 5 shows the cosmogenic contribution to the effective dose rate, which is related to the ambient dose equivalent rate, and also shows the influence of the 11-year solar cycle on the cosmogenic contribution.

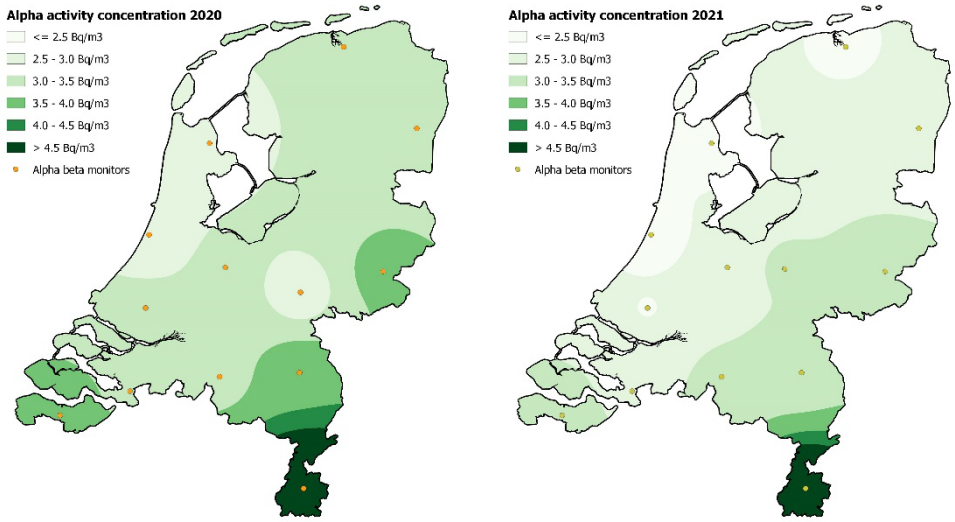

Figure 1 An impression of the spatial variation in the average gross α activity concentration of (mainly) short-lived radionuclides in air dust in 2020 (left) and 2021 (right). Dots represent the locations of the aerosol monitors.

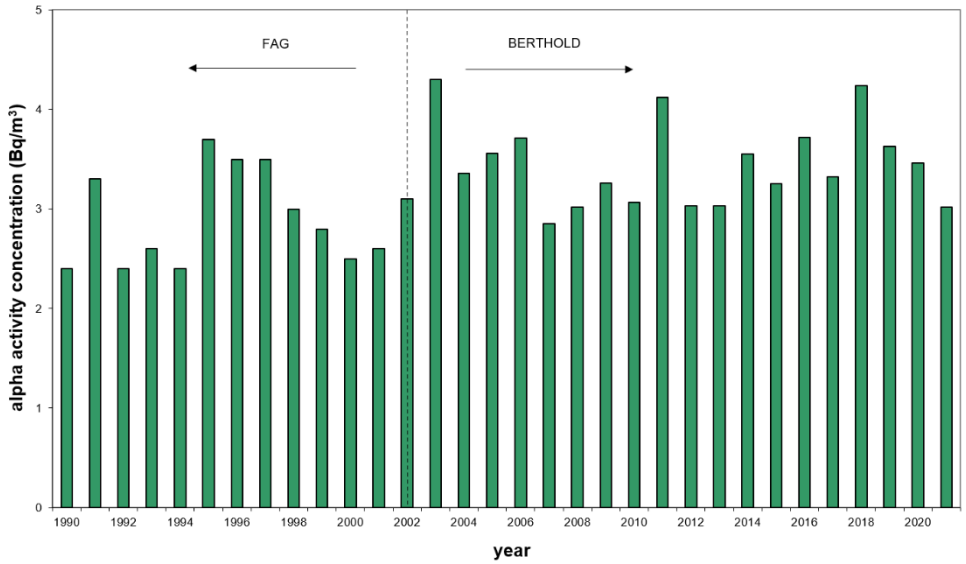

Figure 2 Yearly average gross α activity concentration of (mainly) short-lived radionuclides in air dust. During the second half of 2002, the FAG monitors were replaced by Berthold monitors.

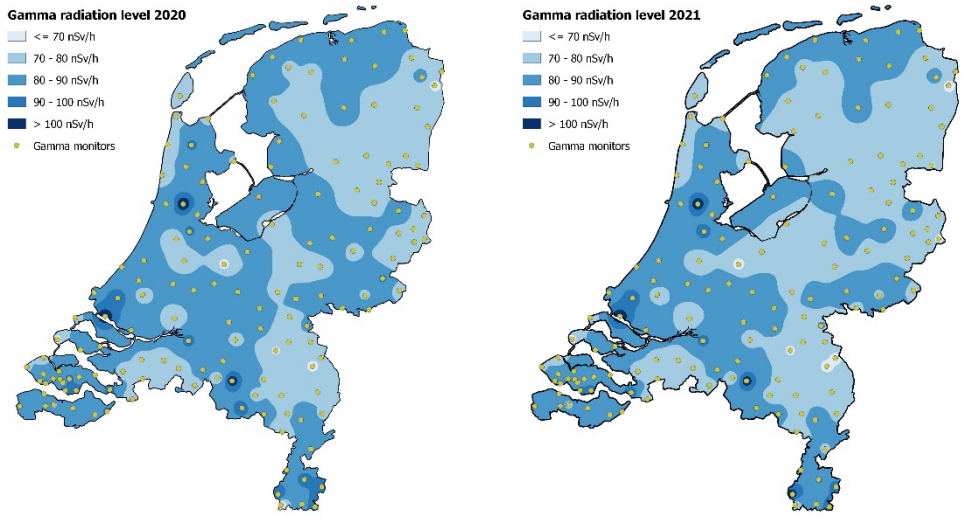

Figure 3 An impression of the spatial variation in the average ambient dose equivalent rate in 2020 (left) and 2021 (right). Dots represent the locations of the dose equivalent rate monitors.

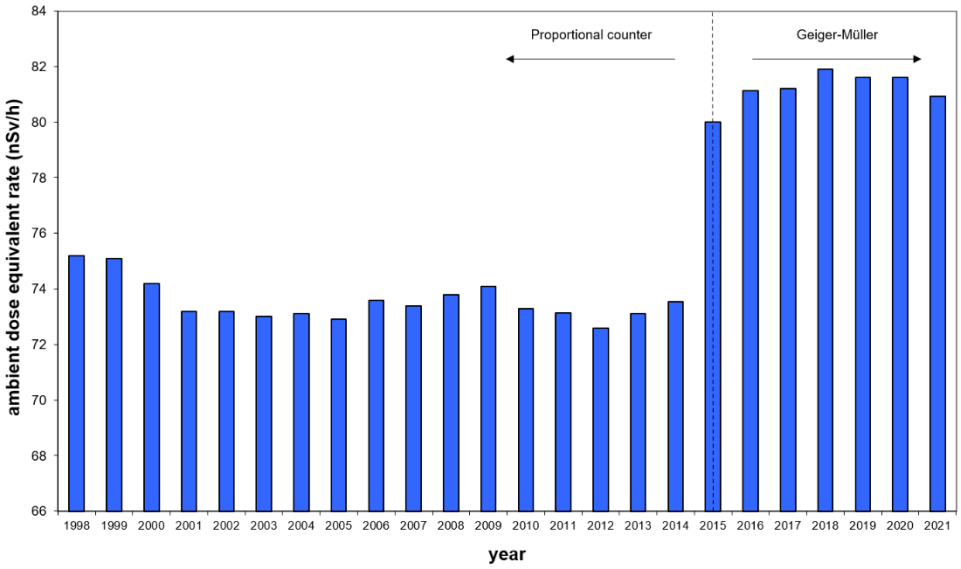

Figure 4 The yearly average ambient dose equivalent rate. During the course of 2015, most of the proportional counter monitors were replaced by Geiger-Müller monitors.

Figure 5 Cosmogenic contribution to the ambient dose equivalent rate (at sea level), influenced by the solar cycle, calculated for the location 51° 26′ north and 3° 43′ east (in the south-western part of the Netherlands) and air pressure 1033 hPa. Figure derived from data supplied by the Federal Aviation Administration [7] and calculated with CARI-7.

Table 1 Yearly average gross α activity concentration in air and ambient dose equivalent rate in 2020, as measured by the NMR stations equipped with aerosol monitors. Given as 5th percentile – average – 95th percentile.

Station	**No.**	**α activity concentration Bq.m^{-3}**	**Dose rate (1) nSv.h^{-1}**
Rotterdam-Tarwewijk(2)	968	0.52 - 3.06 - 8.04	89 - 92 - 96
Arnhem(3)	970	0.59 - 2.59 - 5.70	72 - 75 - 78
Kollumerwaard	972	0.00 - 3.07 - 5.87	85 - 89 - 92
Valthermond	974	0.41 - 3.15 - 8.13	65 - 68 - 73
Braakman	978	0.50 - 3.82 - 10.53	72 - 75 - 79
Huijbergen	980	0.55 - 3.42 - 9.66	64 - 66 - 71
Best-Houtakker	982	0.62 - 3.30 - 9.06	65 - 68 - 72
Wijnandsrade	984	0.94 - 6.84 - 16.53	81 - 85 - 90
Eibergen	986	0.61 - 3.73 - 9.93	65 - 68 - 71
De Zilk	988	0.38 - 2.56 - 7.03	69 - 72 - 77
Wieringerwerf	990	0.42 - 2.62 - 7.18	79 - 82 - 86
Vredepeel	992	0.74 - 3.86 - 10.20	63 - 66 - 71
Bilthoven	998	0.55 - 3.08 - 7.77	65 - 68 - 73

(1) These dose equivalent rate monitors are placed differently from the dose equivalent rate monitors mentioned in Table 3 and Table 4 with regard to height and surface covering.
(2) Station Rotterdam-Tarwewijk is operational from 13 August 2018.
(3) Station Arnhem was dismantled on 3 August 2020.

[7] Federal Aviation Administration. Web page: www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/heliocentric/ (last accessed on 13 October 2022).

Table 2 Yearly average gross α activity concentration in air and ambient dose equivalent rate in 2021, as measured by the NMR stations equipped with aerosol monitors. Given as 5th percentile – average – 95th percentile.

Station	No.	α activity concentration Bq.m^{-3}	Dose rate [1] nSv.h^{-1}
Wekerom[2]	966	0.59 - 3.11 - 8.60	69 - 71 - 75
Rotterdam-Tarwewijk[3]	968	0.45 - 2.48 - 7.32	89 - 91 - 95
Kollumerwaard	972	0.29 - 2.41 - 7.20	85 - 88 - 91
Valthermond	974	0.01 - 2.47 - 7.21	65 - 67 - 72
Braakman	978	0.57 - 3.27 - 7.96	71 - 74 - 78
Huijbergen	980	0.61 - 2.84 - 7.07	63 - 66 - 69
Best-Houtakker	982	0.66 - 3.07 - 7.81	64 - 67 - 71
Wijnandsrade	984	1.02 - 5.89 - 16.18	81 - 84 - 88
Eibergen	986	0.58 - 3.20 - 7.88	63 - 66 - 69
De Zilk	988	0.35 - 2.15 - 6.39	69 - 71 - 75
Wieringerwerf	990	0.35 - 2.23 - 6.69	78 - 81 - 84
Vredepeel	992	0.72 - 3.42 - 9.39	63 - 66 - 70
Bilthoven	998	0.49 - 2.66 - 7.53	65 - 68 - 72

[1] These dose equivalent rate monitors are placed differently from the dose equivalent rate monitors mentioned in Table 3 ans Table 4 with regard to height and surface covering.
[2] Station Wekerom is operational from 16 February 2021.
[3] Station Rotterdam-Tarwewijk is operational from 13 August 2018.

Table 3 Yearly average ambient dose equivalent rate for the NMR stations in 2020. Given as 5th percentile – average – 95th percentile.

Station	No.	Dose rate nSv.h^{-1}	Station	No.	Dose rate nSv.h^{-1}
Den Burg	1001	73 - 76 - 81	Assen	1097	73 - 76 - 80
Den Helder	1002	76 - 78 - 82	Rutten(2)	1099	83 - 86 - 89
Den Oever	1003	74 - 79 - 83	Lelystad	1103	81 - 84 - 88
Petten	1006	65 - 68 - 72	Urk	1105	80 - 83 - 88
Kolhorn	1007	89 - 93 - 98	Eemshaven	1106	82 - 85 - 89
Egmond aan Zee	1009	69 - 72 - 76	Uithuizen	1107	85 - 89 - 93
Heerhugowaard	1011	79 - 81 - 85	Wagenborgen	1109	76 - 79 - 83
Nederhorst Den Berg	1015	80 - 82 - 87	Winschoten	1110	80 - 83 - 88
Velsen	1016	78 - 81 - 85	Ter Apel	1111	71 - 73 - 77
Enkhuizen	1018	76 - 80 - 84	Stadskanaal	1112	71 - 74 - 78
Oosthuizen	1019	77 - 81 - 85	Nieuweschans	1113	76 - 79 - 82
Zaandam(1)	1021	108 - 113 - 122	Bellingwolde	1114	63 - 66 - 70
Gouda	1024	79 - 82 - 86	Groningen	1116	80 - 83 - 87
Dordrecht	1027	67 - 70 - 74	Leens	1117	85 - 88 - 92
Zuid Beijerland	1028	84 - 87 - 91	Grijpskerk	1118	79 - 82 - 87
Zierikzee	1029	81 - 87 - 92	Meppel	1125	70 - 74 - 78
Rotterdam-Schiebroek	1031	71 - 73 - 77	Hoogeveen	1126	68 - 71 - 76
Pijnacker	1032	80 - 86 - 91	Steenwijksmoer	1129	71 - 74 - 78
Maasvlakte	1035	84 - 87 - 91	Nw. Amsterdam	1130	77 - 79 - 83
Maassluis	1037	94 - 98 - 102	Nw. Schoonebeek /Weiteveen	1131	67 - 70 - 74
Hellevoetsluis	1038	109 - 113 - 118	Laren (Gld)	1134	76 - 78 - 83
Ouddorp	1039	70 - 72 - 77	Hengelo (Ov)	1135	76 - 79 - 83
Hoenderloo	1040	69 - 71 - 75	Vroomshoop	1138	71 - 74 - 77
Wageningen	1043	73 - 76 - 80	Enschede	1139	71 - 74 - 77
Amersfoort	1046	76 - 81 - 86	Losser	1140	66 - 69 - 73
Harderwijk	1050	73 - 76 - 81	Oldenzaal	1141	77 - 80 - 84
Wijk bij Duurstede	1056	88 - 91 - 95	Rijssen	1143	84 - 86 - 90
Nieuwegein	1062	87 - 90 - 94	's Heerenberg	1144	77 - 80 - 84
Zegveld	1063	67 - 70 - 75	Dinxperlo	1145	86 - 89 - 93
Lopik (Cabauw)	1064	81 - 86 - 91	Varsseveld	1146	76 - 78 - 83
Apeldoorn	1066	76 - 81 - 87	Groenlo	1147	89 - 93 - 97
Heerenveen	1071	66 - 69 - 73	Deventer	1148	86 - 89 - 94
Oosterwolde	1072	84 - 87 - 92	Etten-Leur	1154	71 - 74 - 78
Bergum	1074	75 - 78 - 82	Den Bosch	1157	75 - 78 - 81
Harlingen	1075	78 - 82 - 89	Raamsdonkveer	1159	93 - 96 - 100
Sneek	1077	77 - 80 - 85	Ulvenhout	1160	70 - 74 - 79
St Jacobiparochie	1081	83 - 88 - 93	Baarle Nassau	1161	75 - 78 - 82
Holwerd	1082	86 - 90 - 95	Mill	1163	70 - 73 - 77
Leeuwarden	1085	75 - 78 - 82	Volkel	1164	64 - 67 - 70
Zwolle	1088	81 - 85 - 90	Oss	1167	79 - 82 - 85
Ommen	1093	71 - 74 - 77	Nuenen	1172	76 - 79 - 84
Hardenberg	1095	72 - 74 - 78	Bergeijk	1174	95 - 98 - 102
Waalre	1175	74 - 76 - 80	Hoensbroek	1225	88 - 93 - 98
Someren (Dorp)	1176	73 - 75 - 79	Eijsden	1227	57 - 60 - 64
Oisterwijk	1178	84 - 88 - 91	Gennep	1228	76 - 80 - 84
Riel	1179	77 - 81 - 86	Elst (Gld)	1229	83 - 86 - 90
Oostelbeers	1180	107 - 110 - 114	Zevenaar	1230	80 - 83 - 87

Station	No.	Dose rate nSv.h^{-1}	Station	No.	Dose rate nSv.h^{-1}
Hilvarenbeek	1181	72 - 74 - 77	Nijmegen	1231	73 - 75 - 79
Venray	1183	64 - 66 - 70	Amstelveen[2]	1233	83 - 95 - 104
Nieuw-Bergen	1184	65 - 69 - 76	Amsterdam	1234	79 - 82 - 87
Sevenum	1185	76 - 79 - 82	Aalsmeer	1236	65 - 68 - 72
Reuver	1188	77 - 79 - 83	Nispen	1237	70 - 73 - 78
Nederweert	1189	76 - 79 - 83	Groesbeek	1240	79 - 82 - 85
Heythuysen	1190	84 - 87 - 91	Tubbergen	1243	87 - 92 - 95
Mariahoop	1191	77 - 80 - 85	Haaksbergen	1244	68 - 71 - 75
Stramproy	1192	68 - 71 - 75	Scheveningen	1247	80 - 84 - 88
Eerbeek	1193	76 - 78 - 82	Zaltbommel	1251	79 - 81 - 85
Leiden	1196	79 - 82 - 86	IJzendijke	1252	83 - 85 - 89
Hulst	1197	85 - 88 - 92	Ritthem	1253	92 - 95 - 99
Terneuzen	1199	79 - 82 - 86	Vlissingen Haven	1254	80 - 83 - 88
Sluis	1201	78 - 81 - 86	Nieuwdorp	1255	81 - 84 - 88
Vlissingen	1202	83 - 86 - 90	's-Heerenhoek[3]	1256	81 - 87 - 93
Halsteren	1204	72 - 75 - 79	Driewegen	1257	93 - 98 - 103
Oud Gastel	1206	75 - 77 - 82	Arnemuiden	1258	83 - 86 - 90
Goes	1207	80 - 83 - 88	Heinkenszand	1259	91 - 95 - 99
Bruinisse	1209	80 - 85 - 90	Baarland	1260	95 - 99 - 103
Burgh-Haamstede	1211	64 - 66 - 71	Biervliet	1261	74 - 77 - 81
Vrouwenpolder	1212	64 - 67 - 71	Nummer Een	1262	84 - 87 - 91
Yerseke	1213	85 - 88 - 93	Rilland[2]	1263	88 - 92 - 97
Middelburg	1215	84 - 89 - 93	Putte	1264	65 - 68 - 73
Westkapelle	1216	72 - 76 - 81	Nieuw Namen	1265	89 - 92 - 96
Maasband	1218	84 - 91 - 101	Beneden Leeuwen	1272	84 - 87 - 90
Maastricht	1220	96 - 101 - 106	Denekamp	1278	71 - 73 - 78
Vaals	1222	93 - 99 - 107	Winterswijk (Kotten)	1279	74 - 78 - 82
Gulpen	1223	82 - 86 - 91	Bilthoven	1280	62 - 64 - 69
Kerkrade	1224	90 - 94 - 99	Gastel (Maarheeze)	1281	79 - 82 - 86

[1] The Zaandam station showed a significantly higher value than most other stations. This is due to a higher background level of the surrounding surface at the site since the end of 2014.
[2] The station Rutten has been relocated to Lemmer, Amstelveen to a new location within Amstelveen and Rilland has been relocated towards Bath in the course of 2020. As a consequence, the 2020 values differ from the values registered in 2019.
[3] The 's-Heerenhoek station was moved a few meters from its original location on 6 May 2019. Before that date it showed a significantly higher value than all other stations due to a higher background level of the ground surface at the site.

Table 4 Yearly average ambient dose equivalent rate for the NMR stations in 2021. Given as 5th percentile – average – 95th percentile.

Station	No.	Dose rate nSv.h^{-1}	Station	No.	Dose rate nSv.h^{-1}
Den Burg	1001	73 - 76 - 79	Lemmer	1098	76 - 78 - 82
Den Helder	1002	75 - 78 - 82	Lelystad	1103	80 - 83 - 87
Den Oever	1003	73 - 77 - 81	Urk	1105	80 - 83 - 87
Petten	1006	66 - 69 - 80	Eemshaven	1106	81 - 84 - 88
Kolhorn	1007	89 - 92 - 96	Uithuizen	1107	84 - 87 - 91
Egmond aan Zee	1009	69 - 71 - 75	Wagenborgen	1109	75 - 78 - 82
Heerhugowaard	1011	78 - 80 - 84	Winschoten	1110	82 - 84 - 88
Nederhorst Den Berg	1015	78 - 81 - 86	Ter Apel	1111	70 - 73 - 77
Velsen	1016	77 - 80 - 83	Stadskanaal	1112	68 - 71 - 76
Enkhuizen	1018	75 - 78 - 81	Nieuweschans	1113	75 - 78 - 81
Oosthuizen	1019	78 - 80 - 84	Bellingwolde	1114	63 - 66 - 69
Zaandam(1)	1021	107 - 111 - 118	Groningen	1116	80 - 82 - 86
Gouda	1024	80 - 83 - 86	Leens	1117	84 - 87 - 90
Dordrecht	1027	67 - 70 - 74	Grijpskerk	1118	79 - 82 - 86
Zuid Beijerland	1028	83 - 85 - 89	Meppel	1125	70 - 72 - 75
Zierikzee	1029	83 - 86 - 90	Hoogeveen	1126	69 - 72 - 76
Rotterdam-Schiebroek	1031	70 - 73 - 76	Steenwijksmoer	1129	70 - 73 - 76
Pijnacker	1032	83 - 85 - 89	Nw. Amsterdam	1130	75 - 78 - 82
Maasvlakte	1035	84 - 86 - 90	Nw. Schoonebeek /Weiteveen	1131	67 - 69 - 73
Maassluis	1037	94 - 98 - 102	Laren (Gld)	1134	75 - 78 - 82
Hellevoetsluis	1038	110 - 113 - 118	Hengelo (Ov)	1135	75 - 78 - 82
Ouddorp	1039	69 - 72 - 76	Vroomshoop	1138	70 - 73 - 77
Wageningen	1043	72 - 75 - 79	Enschede	1139	69 - 72 - 76
Amersfoort(2)	1046	74 - 76 - 80	Losser	1140	65 - 68 - 72
Harderwijk	1050	74 - 76 - 80	Oldenzaal	1141	75 - 78 - 83
Wijk bij Duurstede	1056	87 - 90 - 93	Rijssen	1143	83 - 86 - 90
Nieuwegein	1062	86 - 89 - 92	's Heerenberg	1144	76 - 79 - 84
Zegveld	1063	67 - 70 - 74	Dinxperlo	1145	86 - 88 - 92
Lopik (Cabauw)	1064	79 - 82 - 86	Varsseveld	1146	75 - 79 - 85
Apeldoorn(2)	1066	69 - 72 - 76	Groenlo	1147	88 - 92 - 96
Heerenveen	1071	67 - 69 - 73	Deventer	1148	85 - 88 - 92
Oosterwolde	1072	84 - 87 - 91	Etten-Leur	1154	71 - 74 - 77
Bergum	1074	75 - 78 - 82	Den Bosch	1157	75 - 77 - 81
Harlingen(3)	1075	87 - 89 - 93	Raamsdonkveer	1159	93 - 95 - 99
Sneek	1077	76 - 79 - 83	Ulvenhout	1160	72 - 75 - 79
St Jacobiparochie	1081	83 - 86 - 90	Baarle Nassau	1161	75 - 78 - 82
Holwerd	1082	85 - 89 - 93	Mill	1163	69 - 72 - 77
Leeuwarden	1085	75 - 77 - 82	Volkel	1164	63 - 66 - 70
Zwolle	1088	82 - 84 - 88	Oss	1167	79 - 82 - 85
Ommen	1093	70 - 73 - 77	Nuenen	1172	76 - 79 - 82
Hardenberg	1095	71 - 74 - 78	Bergeijk(2)	1174	71 - 91 - 101
Assen	1097	72 - 75 - 79	Waalre	1175	72 - 75 - 79
Someren (Dorp)	1176	72 - 75 - 78	Eijsden(2)	1227	56 - 71 - 100
Oisterwijk	1178	84 - 87 - 91	Gennep	1228	76 - 80 - 84
Riel	1179	78 - 82 - 87	Elst (Gld)	1229	83 - 85 - 89
Oostelbeers	1180	105 - 109 - 114	Nieuw-Wehl	1230	81 - 84 - 88
Hilvarenbeek	1181	71 - 73 - 77	Nijmegen	1231	72 - 75 - 79

Station	No.	Dose rate nSv.h^{-1}	Station	No.	Dose rate nSv.h^{-1}
Venray	1183	63 - 66 - 69	Amstelveen	1233	94 - 97 - 101
Nieuw-Bergen	1184	63 - 66 - 70	Amsterdam	1234	80 - 82 - 86
Sevenum	1185	74 - 77 - 81	Aalsmeer(5)	1236	-
Reuver	1188	77 - 79 - 83	Nispen	1237	71 - 73 - 76
Nederweert	1189	75 - 78 - 82	Groesbeek	1240	78 - 81 - 85
Heythuysen	1190	83 - 86 - 90	Tubbergen	1243	85 - 88 - 91
Mariahoop	1191	76 - 79 - 83	Haaksbergen	1244	67 - 70 - 74
Stramproy	1192	68 - 71 - 75	Scheveningen	1247	80 - 82 - 86
Eerbeek	1193	75 - 77 - 81	Zaltbommel	1251	78 - 80 - 84
Leiden	1196	78 - 81 - 85	IJzendijke	1252	82 - 85 - 88
Hulst	1197	85 - 87 - 91	Ritthem	1253	90 - 93 - 97
Terneuzen	1199	78 - 80 - 84	Vlissingen Haven	1254	80 - 83 - 87
Sluis	1201	78 - 81 - 85	Nieuwdorp	1255	81 - 83 - 87
Vlissingen	1202	83 - 86 - 89	's-Heerenhoek(6)	1256	81 - 84 - 88
Halsteren	1204	71 - 74 - 78	Driewegen	1257	92 - 96 - 100
Oud Gastel	1206	74 - 77 - 80	Arnemuiden	1258	82 - 85 - 89
Goes	1207	75 - 80 - 86	Heinkenszand	1259	90 - 92 - 96
Bruinisse	1209	83 - 86 - 89	Baarland	1260	95 - 98 - 101
Burgh-Haamstede	1211	63 - 66 - 70	Biervliet	1261	73 - 76 - 79
Vrouwenpolder	1212	64 - 66 - 70	Nummer Een	1262	86 - 88 - 92
Yerseke	1213	84 - 87 - 90	Putte	1264	65 - 67 - 71
Middelburg	1215	82 - 85 - 88	Nieuw Namen	1265	89 - 91 - 95
Westkapelle	1216	74 - 77 - 81	Bath(2)	1271	94 - 98 - 104
Maasband(2)	1218	83 - 85 - 89	Beneden Leeuwen	1272	83 - 86 - 89
Maastricht(4)	1220	100 - 107 - 111	Denekamp	1278	70 - 73 - 77
Vaals	1222	93 - 97 - 103	Winterswijk (Kotten)	1279	75 - 78 - 82
Gulpen	1223	81 - 84 - 88	Bilthoven	1280	61 - 64 - 68
Kerkrade	1224	88 - 92 - 96	Gastel (Maarheeze)	1281	79 - 82 - 86
Hoensbroek	1225	87 - 91 - 95			

(1) The Zaandam station showed a significantly higher value than most other stations. This is due to a higher background level of the surrounding surface at the site since the end of 2014.
(2) The stations Amersfoort, Apeldoorn, Bergeijk, Maasband and Eijsden were relocated in the course of 2020 and 2021. As a consequence, the 2021 values differ from the values registered in previous years.
(3) The monitor of station Harlingen has been replaced in the course of 2021. Therefore, the value of 2021 is different from 2020.
(4) Due to constructions on site, the 2021 values of station Maastricht differ from 2020.
(5) In 2021, station Aalsmeer has been down for too long to calculate a yearly average (less than 150 days operational).
(6) The 's-Heerenhoek station was moved a few meters from its original location on 6 May 2019. Before that date it showed a significantly higher value than all other stations due to a higher background level of the ground surface at the site.

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